Indiana State Department of Health
Epidemiology Resource Center

Carbapenem-Resistant *Enterobacteriaceae* (CRE)

Resource Manual

Introduction to CRE

The issue of antibiotic resistance is global and has had a significant impact in the field of infectious diseases. It has been recognized for several decades that up to 50% of antibiotic use is either inappropriate or unnecessary. Antibiotics are the only drug where use in one person can impact the effectiveness in another. Improving antibiotic use is a public health imperative.

Epidemiologically important organisms are the Gram-negative bacteria *Klebsiella pneumonia* and *Escherichia coli* which are in the family of bacteria known as *Enterobacteriaceae*. The carbapenem-resistant strains of these organisms are referred to as carbapenem-resistant *Enterobacteriaceae* (CRE). Carbapenem-resistant *Klebsiella pneumonia* (CRKP) is the CRE species most commonly seen in the United States. Sometimes these drug-resistant bacteria are referenced to the *Klebsiella pneumoniae* carbapenemase (KPC), the enzyme which inactivates carbapenems. This KPC enzyme is also present in some strains of *Esherichia coli*. The gene that confers this resistance pattern is contained on plasmids, which are highly mobile and very easily spread from one bacteria to the next, harbored in the gut, and potentially transferrable to multiple coliforms. Reported healthcare-associated infections to the CDC showed the overall prevalence of KPC rising from less than one percent in 2000 to eight percent in 2007.

Healthcare providers should be concerned about CRKP infections as they are associated with high rates of morbidity and mortality, serious treatment challenges, increased length of stay, and increased cost. The frequent movement of patients between acute and long term care provides the opportunity for transmission of these resistant organisms. Aggressive communication between both acute and long term care is important so that appropriate intervention can take place.

CRE are an emerging, important healthcare challenge, resistant to almost all current available antibiotics. Pharmaceutical companies are no longer interested in the development of antibiotics. From 1983-1987, sixteen new antibiotics were approved by the US Food and Drug Administration (FDA), but from 2008-2011 only two new antibiotics were approved and neither addressed the issue of resistance. In 1990, nineteen companies developed antibiotics, presently there are four. It will be 5-10 years before new antibiotics are available to treat resistant organisms.

Given this lack of new antibiotics to treat CRE infections an aggressive infection control strategy is critical to prevent the transmission of these resistant organisms. Early detection and implementation of necessary strict infection control measures can prevent carbapenem-resistant organisms in healthcare facilities from becoming a more significant threat to patients.

Microbiology laboratories in all acute care facilities should implement established protocols to detect carbapenemase production in *Enterobacteriaceae.* When these organisms are identified the laboratory should immediately alert acute and long term care infection preventionists allowing for important

control measures to be implemented such as, vigorously practicing hand hygiene, contact precautions, and minimizing the use of devices. Two detailed guidance documents, which include recommendation of active surveillance, the review of microbiology results for past 6-12 months and the cohorting of staff or patients from the CDC and Healthcare Infection Control Practices Advisory Committee (HICPAC) are referenced below in resources.

To slow the evolution of resistance healthcare providers should focus on antibiotic stewardship. Such programs should enforce pathogen-directed therapy and short-course treatment. In a recent study the CDC reported that exposure to a carbapenem antibiotic increased a patient's risk of getting an infection with a carbapenem-resistant strain by 15 times. When ordering antibiotics healthcare providers are encouraged to appropriately select antibiotics including specific dose, duration, route and an indication. Antibiotic use should be reassessed after 24 to 48 hours to review susceptibility results and determine if treatment can be altered. Further detailed guidance describing the development an antibiotic stewardship program from Infectious Diseases Society of America (IDSA) and Society for Healthcare Epidemiology of America (SHEA) is referenced below in resources.

The goal of the Indiana State Department of Health (ISDH) is to heighten awareness of the challenges posed by antibiotic resistance and specifically the highly drug resistant Gram-negative bacteria. The combination of a comprehensive infection prevention program and effective antibiotic stewardship will minimize the emergence and transmission of CRE.

The following Carbapenem-resistant *Enterobacteriaceae* Resource Manual includes information from the ISDH to information for the general public and detailed medical guidelines for healthcare professionals. We hope this information will be helpful in reducing your risk of infection and providing healthcare personnel with the most current information on CRE. The inclusion of documents and lecture's in this Carbapenem-resistant *Enterobacteriaceae* Resource Manual does not constitute an endorsement of any product or company by the ISDH.

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Information for Healthcare Providers

- Healthcare Guidelines
    - Guidance for Control of Infections with Carbapenem-Resistant or Carbapenemase-Producing Enterobacteriaceae in Acute Care Facilities (CDC, 2009)

- Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CDC, 2012)

- Guidance: Infection Prevention and Control Measures for Healthcare Workers in All Healthcare Settings (Public Health Agency of Canada, 2012)
http://www.phac-aspc.gc.ca/nois-sinp/guide/ipcm-mpci/ipcm-mpci-eng.php

- 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings (HICPAC)
http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf

- Journal Articles

  - CRE Infection for Clinicians, CDC
http://www.cdc.gov/hai/organisms/cre/cre-clinicians.html

  - CRE Resource Page, ISDH
http://www.in.gov/isdh/25499.htm

  - CRE Infection Prevention and Control Measures for Hospitals, Minnesota Department of Health, 2012
http://www.health.state.mn.us/divs/idepc/dtopics/cre/cre.pdf

- Presentations

  - "Carbapenem Resistance in Enterobacteriaceae – An Infection Control Emergency" Paul Schreckenberger, Ph.D(ABMM)
http://www.health.state.mn.us/divs/phl/mls/Lab-Training/mima_lecture_jan09.pdf

  - "Carbapenamases in Antibiotic Resistance" Dr. T. V. Rao
http://www.docstoc.com/docs/38844019/Carbapenamases-in-Antibiotic-Resistnace

  - "Carbapenem Resistance in the United States: What Should Clinicians Do?" Arjun Srinivasan, MD; Alexander Kallen, MD, MPH
http://www.medscape.com/viewarticle/733113?src=mp&spon=24

  - "CDC Commentary: Preventing Carbapenem – Resistant Enterobacteriaceae" Arjun Srinivasan, MD
http://www.medscape.com/viewarticle/713709?src=mp&spon=24

Related Topics

- Antimicrobial Stewardship

  - Alliance for the Prudent Use of Antibiotics (APUA)
http://www.tufts.edu/med/apua/

  - Get smart for Healthcare, CDC
http://www.cdc.gov/getsmart/healthcare/

  - CDC's Get Smart: Know When Antibiotics Work Program - Information for Providers

  - IDSA and SHEA Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship (January 2007)

- SHEA and IDSA Joint Committee on the Prevention of Antimicrobial Resistance: Guidelines for the Prevention of Antimicrobial Resistance in Hospitals (April 1997)

- Hand Hygiene
  - Clean Care is Safer Care, World Health Organization Campaign
    http://www.who.int/gpsc/en/
  - General Hand Hygiene Posters, Department of Veterans Affairs
    http://www.publichealth.va.gov/flu/materials/posters_hand_hygiene.asp
  - Guideline for Hand Hygiene in Health Care, 2002, CDC
    http://www.cdc.gov/handhygiene/Guidelines.html
  - Guidelines on Hand Hygiene in Health Care, 2009, WHO
    http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf
  - Hand Hygiene Saves Lives: Patient Admission Video, CDC
    http://www.cdc.gov/handhygiene/Patient_materials.html

General Public

- Antibiotic Resistance
  - Antibiotic Use and Antibiotic Resistance Quick Facts, ISDH
    http://www.in.gov/isdh/25507.htm
  - Antibiotic Safety, APIC
    http://www.apic.org/For-Consumers/IP-Topics/Article?id=antibiotic-awareness-101
  - Get Smart: Know When Antibiotics Work, CDC
    http://www.cdc.gov/getsmart/
  - Hospital vs. Home Setting Precautions for Antibiotic Resistant Bacteria Fact Sheet, Texas State Department of Health Services
    http://www.dshs.state.tx.us/idcu/health/antibiotic_resistance/mrsa/antibio_edu_home_hospital.pdf
  - Indiana Coalition for Antibiotics Resistance Education Strategies (ICARES), Marion County Public Health Department
    http://www.icares.org/
  - Information for Everyone, CDC
    http://www.cdc.gov/getsmart/specific-groups/everyone.html
- Carbapenem-resistant Enterobacteriaceae Infection
  - CRE Infection for Patients, CDC
    http://www.cdc.gov/hai/organisms/cre/cre-patients.html
- Hand Hygiene
  - Handwashing Campaign, ISDH
    http://www.in.gov/isdh/24036.htm
  - Handwashing Quick Facts, ISDH

http://www.in.gov/isdh/25483.htm

- Hand Hygiene Educational Training, CDC
http://www.cdc.gov/handhygiene/training.html

All information presented is intended for public use.
This Manual was last reviewed September 4, 2012.